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Memory and storage for base and surface sentence forms were compared by examining memory for these kinds of sentences. It was hypothesized that a subject hearing a sentence transforms it to its base form, stores it in this form, and recalls it, again transforming it, in its surface form. Thirty undergraduate educational psychology students, divided randomly into two groups, heard 50 taped sentences, each followed by a list of eight unrelated words. Half of the sentences were in base form; half, in surface. After they heard each sentence and its list of words, a buzzer signaled them to repeat the sentence and a second buzzer signaled them to repeat the wordlist. They were given unlimited time for recall. Mean number of words recalled did not differ significantly for groups or for structure or type. Significantly greater numbers of errors were made by subjects when attempting to recall the surface structure form than when attempting to recall the base form. Duncan multiple range test showed that some sentence types (SVO+VO and SVO+O) were more difficult to recall than other types but that they were not significantly different from one another. Group 2 made relatively more errors on surface forms than did group 1. It was concluded that grammatical structure appears to influence the three processes (decoding, storage, and encoding) of sentence recall. References are included. (MD)

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RECALL OF BASE AND SURFACE FORMS OF SENTENCES

by

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The transformationalist model of grammar describes the knowledge possessed by the speaker of his language. As such, it has rich implications for the ways in which one goes about processing sentences, and psycholinguists have been working on the construction of a perceptual model of speech recognition based upon it. This perceptual model assumes that structural descriptions proposed by the grammar, along with other psychological mechanisms, are part of a package that the speaker uses to understand the sentences of his language. Basically, the model proposes that on hearing a sentence, the speaker analyzes the surface structure, then analyzes its base structure which contains the semantic component. Finally, he re-analyzes the surface structure.

Establishment of the psychological reality of the structural descriptions as proposed by the transformational model has been the focus of a considerable amount of research in psycholinguistics. Length of derivational history from the base form has been found to be influential in recall. Savin and Perchonock (1965), for example, hypothesized that sentences which require a greater number of transforms take more storage room than those requiring fewer operations. This implies that transforms are processed before being stored in memory. To test this, they asked subjects to repeat sentences and a list of unrelated words. The number of words recalled after the sentence was used was taken as an index of the amount of room left in memory after the sentence was processed. Transforms used were of the active, passive, negative, question type.

Several other studies indicate that the kinds of structural complexities are not relevant in the case of recall, such as complexity of the verb phrase. The picture that the literature presents concerning the psychological reality of the rule complexity in sentences is somewhat muddled. Since some studies indicate that more complexity in rules appears not to be enough to define psychological complexity, Savin and Perchonock's results apparently hold only for certain transforms. A possible interpretation is that types of grammatical struc-

tures are real psychologically, but that the operations suggested by the idealized description of the grammar are not.

The focus of this experiment concerns the examination of memory for surface structure of a sentence and its corresponding base form. The base structure, as reflected in the base P marker, represents the formal meaning of the sentence. In the case of the simple affirmative active declarative sentence, or kernel, the structural description of the base P marker form may have the same surface structure form.

But in the case of the compound sentence, the surface structure form may be quite different in form from its base, although only one transform is necessary to produce it.

Consider the sentence, "John likes potatoes and Mary plays badminton." It has two nouns, two verbs, and two objects, and it is a base P marker form. Consider another sentence, "John likes potatoes and badminton." To make sense of it, we must recognize that it is John who likes both badminton as well as potatoes, and that since there is a second verb, we know that he likes rather than hates them. So this sentence, which has only one verb and object in the surface structure form, actually has the same base P marker form as the first sentence, namely two nouns, two verbs, and two objects.

We can therefore compare memory and storage for base and surface forms of sentences by examining memory for these kinds of collapsible sentences. The thesis of this experiment is that a subject, on hearing a sentence, transforms it to its base form, and stores it there in this form, and when asked to recall it, will again transform it, this time, back to its surface form.

The experiment also hypothesizes that if the transformation from base to surface form is difficult for the subject, he should store a smaller amount of additional information in his memory when recalling a surface different from the base form than recalling a surface like its base P marker form. Further,

he should make fewer errors on recall of the base P marker form, which requires no further transformation after storage. This will be true despite the greater length of the base P marker form. Therefore this experiment proposes that structural complexity of a sentence is a more relevant dimension in recall than length is.

Finally, relative difficulty of various surface structure forms will be examined. It is hypothesized that some forms will be more difficult to recall than others, because of their infrequency of occurrance in the language.

Thirty undergraduate educational psychology students participated in the experiment as part of a course requirement. Each subject heard a taped list of fifty sentences, each followed by a list of eight unrelated words. After they heard each sentence and its corresponding list of words, a buzzer signaled them to repeat the sentence, and a second buzzer signaled them to repeat the list of words. They were given an unlimited amount of time for recall.

Ten sets of five sentences each were constructed so that each of the five sentences represented a different surface structure form. An example of a sentence set is given in Figure I. Subjects were divided randomly into two groups. Both groups received 25 sentences in the base P marker form, and 25 in the surface form. Group I received the sentences in the surface structure form that Group II received in the base form. Each group received 10 sentences of each of the five types; five of them in base form, and five in surface form. Thus the two groups performed identical tasks, but on different sets of materials.

(Insert of FIGURE I on following page)

Fifty lists of 8 unrelated words were constructed so that each one was a member of each of 8 categories. The order in which the categories occurred was the same for every list, and each subject was given a list of the categories in order to aid recall. Each subject received all 50 lists.

FIGURE I

A Sample Sentence Set

	Surface Structure Form	Base P Marker Form
1. SVO+VO	Boys paint pictures and fly airplanes.	Boys paint pictures and boys fly airplanes.
2. S+SVO	Boys and men paint pictures.	Boys paint pictures and men paint pictures.
3. S(V+V)O	Boys paint and fly airplanes.	Boys paint airplanes and boys fly airplanes.
4. SVO+O	Boys paint pictures and airplanes.	Boys paint pictures and boys paint airplanes.
5. SV+SVO	Boys paint and men fly airplanes.	Boys paint airplanes and men fly airplanes.

Word lists were counterbalanced with sentence types and sentence sets by rotation and each word list occurred with each sentence type exactly once. This was done so that better performance on one sentence type would not be due to an easier word list. All words from the lists and all words from the sentences were of A or AA frequency as measured by the Lorge Thorndike frequency count.

Mean number of words recalled per group per structure per type were tabulated and these are indicated in Table I. In addition, errors on sentences were tabulated for each subject. The statististical design used for both analyses was a three factor mixed design on repeated measures.

(Insert of TABLE I on following page)

As one might suspect from examining the means, analysis showed that mean number of words recalled did not differ significantly for groups or for structure or for types.

Analysis of errors on sentences, however, was a little more interesting. Significantly greater number of errors were made by subjects when attempting to recall the surface structure form, than when attempting to recall the base P marker form. This is according to prediction.

(Insert of TABLE II on following page)

Kind of sentence type is also significant; a duncan multiple range test for multiple comparisons showed that sentence types 1 and 4 (SVO+VO and SVO+O) were more difficult to recall than the three other types, but were not significantly different in difficulty from each other.

Interactions between these effects were also found to be significant. Group II made relatively more errors on surface forms than did Group I, a result which is probably due to the strength of the main B effect.

TABLE I

Mean Number of Words Recalled
For Sentence Structures and Sentence Types

Sentence Type:	Sentence Structures: Base	surface
1. SVO+VO	4.61	4.73
2. S+SVO	4.78	4.54
3. S(V+V)O	4.58	4.51
4. SVO+O	4.65	4.61
5. SV+SVO	4.34	4.39

TABLE II

Number of Errors on Sentence Recall

Total	1543.1	299	-	-	
Between Groups	167.1	29	-	-	
Groups (A)	15.43	1	15.43	3.7	ns
error	152.53	28	5.44	-	
Within S.	1375.6	270	-	-	
Structure (B)	61.6	1	61.6	22.1	*.01
Type (C)	194.7	4	48.6	17.3	*.01
AxB	56.7	1	56.70	20.25	*.01
AxC	63.8	4	15.92	5.68	*.01
BxC	72.4	4	18.10	6.42	*.01
AxBxC	81.1	4	20.20	7.21	*.01
error	704.8	252	2.8	-	

Significant interactions were also found between groups and sentence types, between sentence structure and types, and between groups and sentence structure and type. These results indicate that group II performed relatively less well on the SVO+O and SVO+VO types and that surface structure form of these types of sentences were less well recalled than the base P marker form. Finally, Group II performed relatively less well on the surface forms of the SVO+O and SVO+VO types.

Recall of sentences requires that three processes be completed successfully--decoding, storage and encoding. Grammatical structure appears to influence all of them. It is reasonable to assume that in order that a shorter sentence not be recalled as well as a longer one, something has to happen to it in processing. If these shorter sentences are more complex syntactically, then the speaker probably simplifies them in order to store and recall them. Results do indicate that the longer base P marker form is recalled as easily as its surface structure form, and that individuals make fewer mistakes in attempting to recall the base P marker form. A possible interpretation is that subjects do indeed transform to the base form, and so on recall of this form, fewer errors are made despite length.

Results of this experiment do not indicate that more complex sentences take up more room in the memory store than the less complex ones. One possible difference between the findings here and those of Savin and Perchonock is that the complexity of the sentence in the Savin and Perchonock experiment is measured by the number of transforms necessary to transform to the kernel sentence. In this experiment, only one transformation is neccessary in each case. However, despite the fact that the grammatical model claims greater complexity of transforms and consequently a smaller amount of storage in the case of surface structure description, results did not turn out this way. The process involved does not appear to match the idealized description of the grammar. There is no reason to assume that the structural descriptions of the sentences are not psychologically real, but it is possible that the processes that these descriptions suggest are not.

The generative grammar is not supposed to be a description of the perceptual device one uses in analyzing sentences, but an idealized description of structure. A speaker may well use quite different kinds of processes than those implied by the idealized description. Analysis of input may be a kind of template-matching process, and as such may be of an entirely different form than that process used in recall. Recall using complex processes may not be more difficult despite their failure to take up much storage room. Difficulty of structural description may thus not be a proper index of complexity of processing. It seems clear that a number of process mechanisms may be operating in recall which may be different in the encoding, storage and decoding processes, and which may be different in nature from the description of a grammar, and these processes may be different in long term than in short term memory. Questions such as these must be of concern in future psycholinguistic research.

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